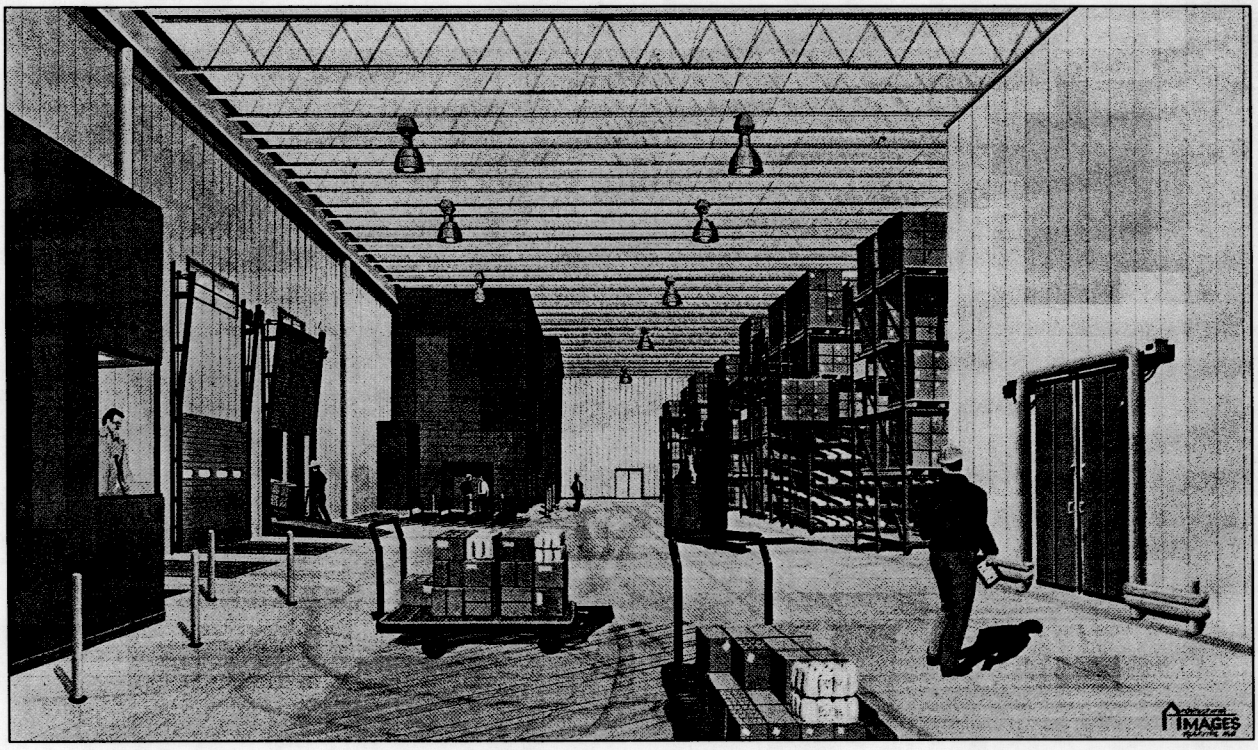
Department of the Army
Facility Standardization Program

US Army Troop Support Agency
Fort Lee, Virginia

Troop Issue Subsistence Activity
Cold / Dry Storage Facilities
TISA



US Army Corps of Engineers
Norfolk District

October 1988

INTRODUCTION

This standard definitive design package has been developed as a guide for design of small, medium and large "TISA" Cold/Dry Storage Facilities throughout the Continental United States (CONUS). The following unique functional and technical requirements must be considered for adaption of this standard Outside the Continental United States (OCONUS):

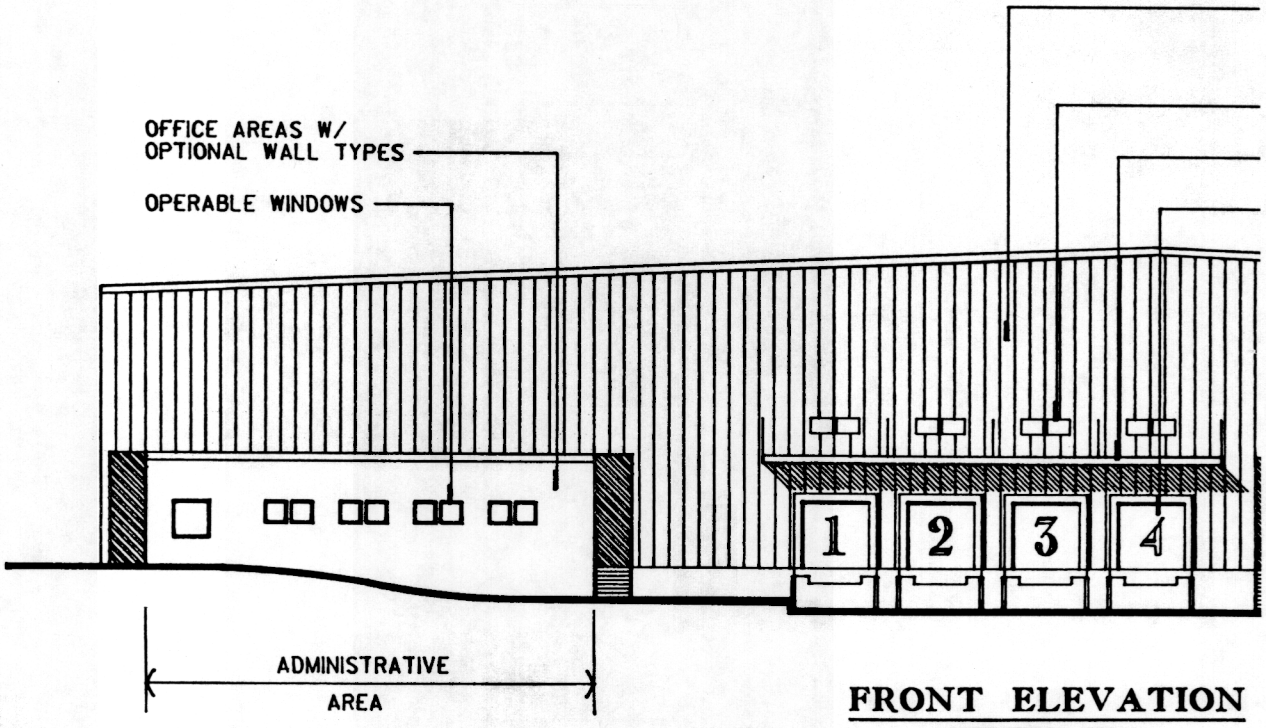
- Exterior Lighting for Administrative and Breakroom areas
- External Forklift Charging Station
- External Hook-up for Reefer Vans
- Below grade sprinkler water storage
- Railroad spurs
- Dock configuration for side loading/unloading
- Alternate wartime uses

The purpose of this design package is to provide standard functional layouts and criteria for sizing TISA Cold/Dry Storage Facilities for the Department of the Army Facilities Standardization Program. The specific sizing criteria and process is included to aid in the preparation of DD Form 1391. In addition, this package serves as a guide to military design agencies and A/E firms in the application of the design to a specific project.

The process and criteria for sizing have been developed to determine the overall storage requirements based on the installation's categories of troop strength. An example of this process is included in the Review and Analysis Document. The overall storage requirements will be determined by the installation's master planner and Troop Issue Subsistence Officer with assistance from the US Army Troop Support Agency. The installation's calculated storage requirements will be verified by the major command and TSA via site visit. TSA will utilize the verified storage requirements to determine square footage and optimum facility configuration prior to preparation of DD form 1391 by the installation. TSA's involvement will extend through the concept phase of design.

The facilities have been developed based on average levels of troop strength for each individual category. The plans further reflect an organizational concept which allows flexibility and expansion of the facility. Integral and mandatory elements of this design package are the storage aid systems and the material handling equipment.

This definitive design package has been developed and reviewed with assistance from the US Army Troop Support Agency, Forces Command, Training and Doctrine Command, Headquarters - US Army Corps of Engineers and the US Army Corps of Engineers - Norfolk District.



FRONT ELEVATION
MEDIUM TISA

OVERVIEW

The state-of-the-art in storage, material handling and control of warehouse related functions has changed dramatically in the past 15 to 20 years. The most noticeable is the increase in the variety of material handling equipment. Each of the alternative material handling vehicles has spawned variance in storage aids. In other cases, innovation and education coupled with the increased cost of labor and facilities has broadened the use of storage aids such as case and pallet flow racks, multiple deep pallet racks and other systems which have gone relatively unnoticed.

The most significant state-of-the-art change in warehouse systems design has been the integration of the computer into the warehousing functions to organize and control the elements which cause ineffective use of storage space, material handling equipment, lost time and record keeping functions. A small computer performing warehouse location control functions, cyclic inspections and logging issues/receipts which effect the physical inventory control rather than accounting control would have a payback period of approximately 1 to 2 years based on the experience of the commercial food service distribution industry.

The warehousing systems presented in the definitives are based on alternative storage aids, material handling systems and warehouse layouts used by the more progressive establishments in the food service industry based on equivalent inventories and throughput levels. The definitive designs are equally efficient for issue picking by government personnel, mini/maxi mart customers or in contractor operated facilities.

MANDATORY AND OPTIONAL ELEMENTS

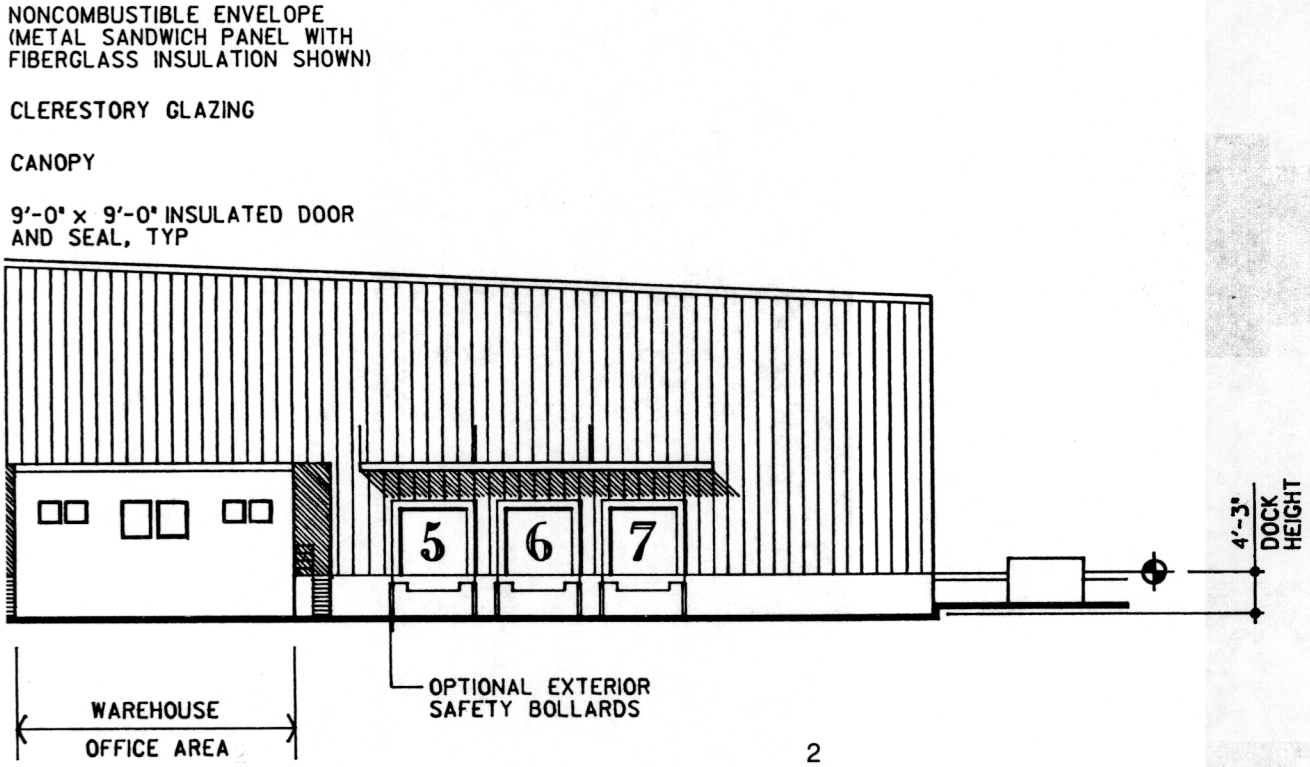
A summary of the major mandatory and optional elements of this design package are listed as follows.

Mandatory

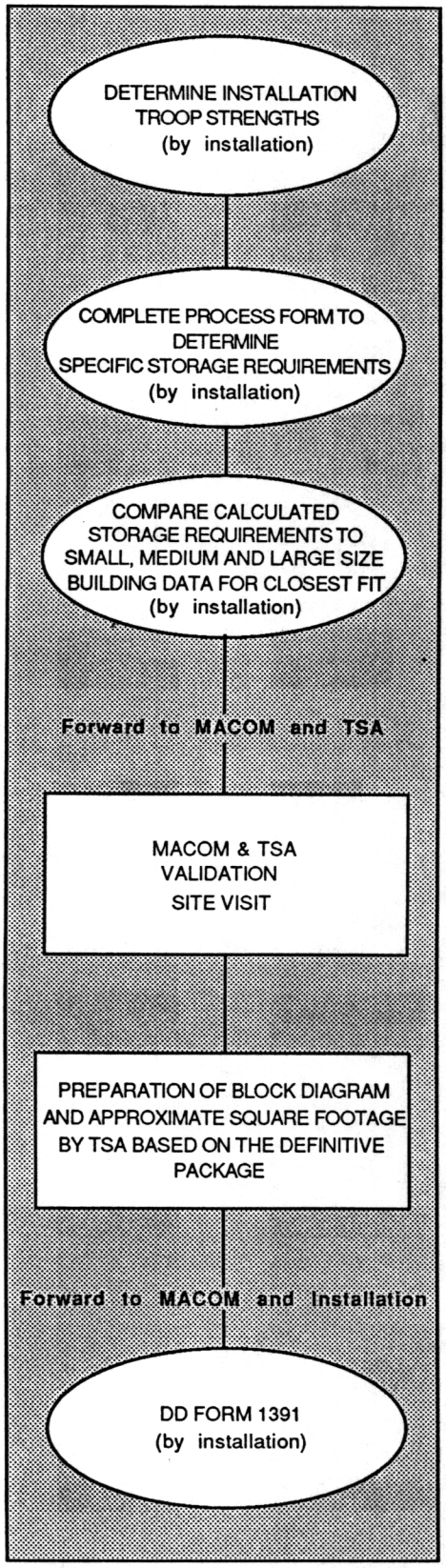
- Functional relationships
- Data tables
- Process for sizing
- Days of supply (also minimum)
- Noncombustible exterior envelope
- Low temperature storage interior envelope
- Storage aid systems
- Material handling equipment
- Sprinkler systems
- Aisle widths
- Emergency generator hook-up

Optional

- Mini/maxi mart function
- Reach-through option at maxi mart aisle
- Exterior envelope type
- Office area wall types
- Engineering systems
- Mechanical equipment location
- Emergency generator



DETERMINATION OF TOTAL STORAGE REQUIREMENTS



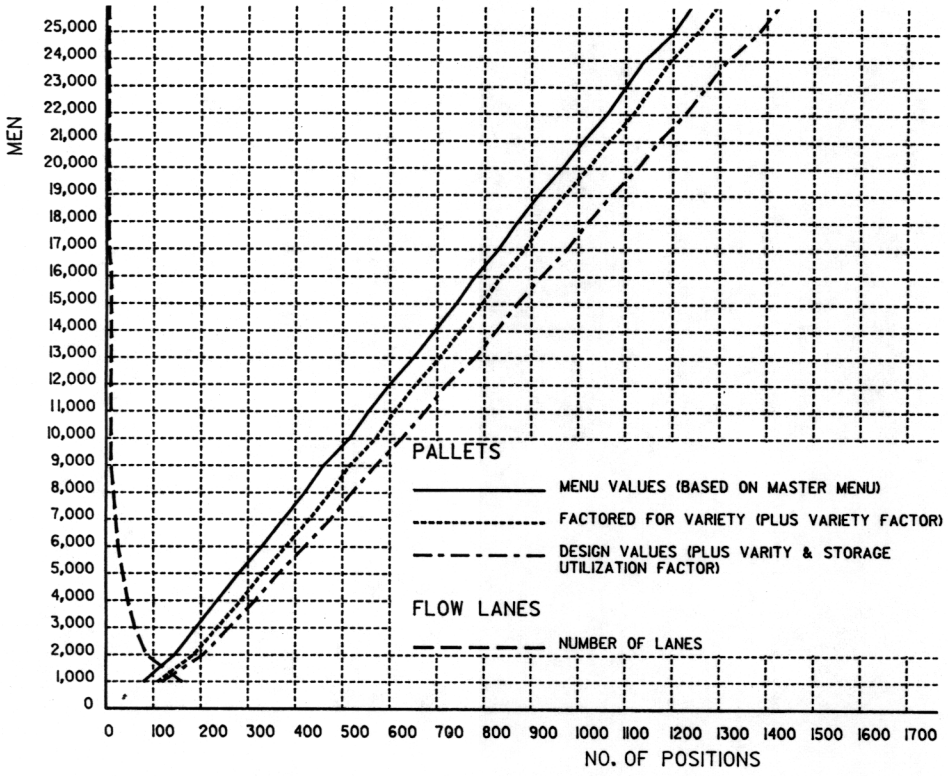
The size and shape of a TISA warehouse is dependent on the troop strength the facility is to support and the number of storage areas required within the facility based on storage temperatures and humidities necessary to accommodate the range of subsistence items. This definitive allows adaptation to the TISA requirements based on locally computed troop strengths giving consideration to variance in the storage inventory in dry (semi-perishable); freezer; perishable cooler; sensitive, hardy vegetable and fruit coolers; onion and potato storage as well as MRE and T-Rations.

A series of design storage inventory tables have been developed by storage area type for A- Rations, MRE, T-Rations and A-Rations which are required to supplement other rations. The design storage inventory has been based on the master menu planning system and accounts for the seasonal variance in inventory. The menu line items (ML's) as expressed in the master menu have been increased by 50 percent. This allows for variance through the use of alternative national stock numbers (NSN) or local stock number items procured by a TISA. Stock numbers with small fractional pallet inventories are stored in case flow lanes. One lane is provided for full case selection and one for partial case selection (a 100% factor). Inventory with case quantities greater than those defined for flow lanes are intended to be stored in pallet or multi-deep drive-in racks. A 10 percent allowance for pallet rack and a 15 percent allowance for multi-deep drive-in racks have been included in the design inventory to account for losses due to lot size variance and fluctuations in turnover rates.

DATA TABLES

MEN	DRY STORAGE						
	A-RATIONS			A-RATIONS (CONDIMENTS)			MRE (MEALS READY TO EAT)
	PALLET POSITIONS		FLOW LANES	PALLET POSITIONS		FLOW LANES	PALLET POSITIONS
	REQ'D	ML'S	REQ'D/ML'S	REQ'D	ML'S	REQ'D/ML'S	
1,000	120	89	160	24	21	222	30
2,000	205	125	88	33	24	216	60
3,000	260	138	60	68	50	166	90
4,000	314	146	46	76	53	160	120
5,000	363	152	34	90	59	148	150
6,000	421	156	24	102	60	144	180
7,000	473	159	18	121	72	120	210
8,000	522	161	16	132	77	112	240
9,000	568	162	12	140	77	112	270
10,000	625	164	10	148	80	106	300
11,000	673	164	10	159	80	106	330
12,000	722	164	10	168	80	106	360
13,000	778	164	10	179	81	102	390
14,000	825	164	10	183	81	102	420
15,000	872	164	10	192	84	96	450
16,000	918	164	10	198	84	96	480
17,000	974	165	6	209	87	90	510
18,000	1020	165	6	217	87	90	540
19,000	1069	165	6	226	87	90	570
20,000	1124	165	6	238	89	88	599
21,000	1172	165	6	246	89	88	629
22,000	1225	165	6	255	90	84	659
23,000	1271	165	6	266	92	82	689
24,000	1316	165	6	273	92	82	719
25,000	1379	165	6	281	93	78	749

RATION GRAPH



The days of supply incorporated into the tables are as follows:

Dry (semi-perishable)	:	30 days
UHT Milk	:	15 days
Freezer	:	30 days
Ice "T" supplement	:	3 days
Perishable cooler	:	30 days
Fresh milk	:	3 days
Bread	:	3 days
Sensitive vegetable	:	3 days
Sensitive fruit	:	7 days
"T" supplement	:	3 days
Onions and potatoes	:	15 days
MRE and T-rations	:	15 days

The process form shown on the right is used to calculate the storage inventory. The form must be completed in line number sequence. The storage inventory values versus troop strength for all ranges of values are not linear. It is necessary, therefore, to develop the composite troop support requirement in the top section of the form and interpolate the tables.

Inventory values should not be constructed by adding different lines of the tables.

The philosophy of troop strength support calculations is as follows:

- Full A-rations or equivalent:
  barracks capacity
  hospital bed capacity
  14 day reserve training schedule
- Cash sales
  15% troops (historical average)
- Weekend reserves
  2 lunches per weekend based on ratio of 2 weekend lunches (volume) per week to full A-ration (volume) per month.
- MRE & T-rations
  2 T-rations and 1 MRE ration with supplementary support per man per day in the field.

The data tables and process form are mandatory elements of the sizing criteria. The days of supply are mandatory and minimum required.

PROCESS FOR DETERMINATION OF TOTAL STORAGE REQUIREMENTS

ENTER TROOP STRENGTHS PER CATEGORY.

1	Barracks capacity	_____
2	TRADOC facility (line 1. x .95)	_____
3	FORSCOM facility (line 1. x .70)	_____
4	14 days reserves in training	_____
5	Hospital bed capacity	_____
6	Total (line 2 or 3 + 4 & 5)	_____
7	Cash sales (line 2 or 3 x .15)	_____
8	Total (lines 6 and 7)	_____
9	Weekend reserves - 2 lunches per weekend weekend reserves supported	_____

FACTOR APPROPRIATE TROOP STRENGTH CATEGORIES INTO A COMPOSITE NUMBER FOR A-RATION DETERMINATION.

10 Dry line 9 x .075 = _____ + line 8 _____ = _____
11 Dry- accessories & condiments (A & C)
line 9 x .075= _____ + line 8 _____ = _____
12 Freezer
line 9 x .064= _____ + line 8 _____ = _____
13 Perishable cooler
line 9 x .065= _____ + line 8 _____ = _____
14 Sensitive vegetable & fruit cooler
line 9 x .130= _____ + line 8 _____ = _____
15 Hardy vegetable & fruit cooler
line 9 x .211= _____ + line 8 _____ = _____
16 Onions & potatoes
line 9 x .072= _____ + line 8 _____ = _____

DIRECTLY ENTER DATA POINT TABLES WITH COMPOSITES NOS. FROM LINES 10-16. INTERPOLATE AS REQUIRED AND DETERMINE THE A-RATIONS REQUIREMENT PER STORAGE AREA.

		PALLETS	ML'S	LANES
17 Dry - W/O A & C	line 10	_____	_____	_____
18 Dry - A & C	line 11	_____	_____	_____
19 Dry total	line 17 & 18	_____	_____	_____
20 Freezer	line 12	_____	_____	_____
21 Cooler - perishable	line 13	_____	_____	_____
22 Sensitive vegetable & fruit cooler	line 14	_____	_____	_____
23 Hardy vegetable & fruit cooler	line 15	_____	_____	_____
24 Onions & potatoes	line 16	_____	_____	_____

DETERMINE TROOP STRENGTHS FOR FIELD FEEDING AND ENTER DATA POINT TABLES, DESIGN VALUES, TO DETERMINE MRE, T-RATION AND SUPPORT ITEMS REQUIREMENTS PER STORAGE AREA.

	PALLETS
25 T & MRE rations men in field (per training months)	_____
26 Dry - T-rations	_____
27 Dry - milk (uht)	_____
28 Dry - MRE	_____
29 Total dry (line 26+27+28)	_____
30 Freezer (ice)	_____
31 Cooler - perishable (bread)	_____
32 Cooler - hardy vegetable & fruit (fruit)	_____

ADD THE INDIVIDUAL STORAGE REQUIREMENTS FROM STEPS 17-24 & 25-32 AS INDICATED TO DETERMINE THE GROSS NO.S OF PALLETS AND FLOW LANES FOR EACH STORAGE AREA.

		PALLETS	ML'S	LANES
33 Dry - A-rations	line 19	_____	_____	_____
34 Dry -T, MRE rations	line 29	_____	_____	_____
35 Freezer	line 20+30	_____	_____	_____
36 Cooler - perishable	line 21+31	_____	_____	_____
37 Cooler - sensitive vegetable & fruit	line 22	_____	_____	_____
38 Cooler - hardy vegetable & fruit	line 23+32	_____	_____	_____
39 Onions & potatoes	line 24	_____	_____	_____

SUMMARY
THE TOTAL STORAGE REQUIREMENTS SHALL BE COMPARED TO THOSE FOR EACH SIZE DEFINITIVE (SEE BUILDING DATA ON SHEETS 4, 5 & 6). THE APPROPRIATE DEFINITIVE SHALL FORM THE BASIS BY WHICH TSA WILL DEVELOP A BLOCK DIAGRAM AND APPROXIMATE SQUARE FOOTAGE REQUIREMENT FOR THE INSTALLATION.

FUNCTIONAL AND OPERATIONAL REQUIREMENTS

This standard has been designed to meet the functional and operational requirements for "TISA" Cold/Dry Storage Facilities. The support capacities for various troop strengths, administrative and warehouse personnel along with the associated storage capacities of key warehouse areas are specifically defined for each size facility.

The plan is organized into four functional areas; storage, administrative, warehouse office and support spaces. These areas are organized by a linear spine containing the support functions which serve and organize access to the individual storage areas. In the medium and large sizes, the warehouse office area is centrally located for access to and control of the dock functions. The administrative office area is located so as to not interfere with warehouse related functions and to maintain its primary relationship to POV parking while allowing specific internal spaces such as break-training and toilets to be easily accessible from all areas within. The functional relationships are a mandatory element of the design. The four functional areas are further defined as follows:

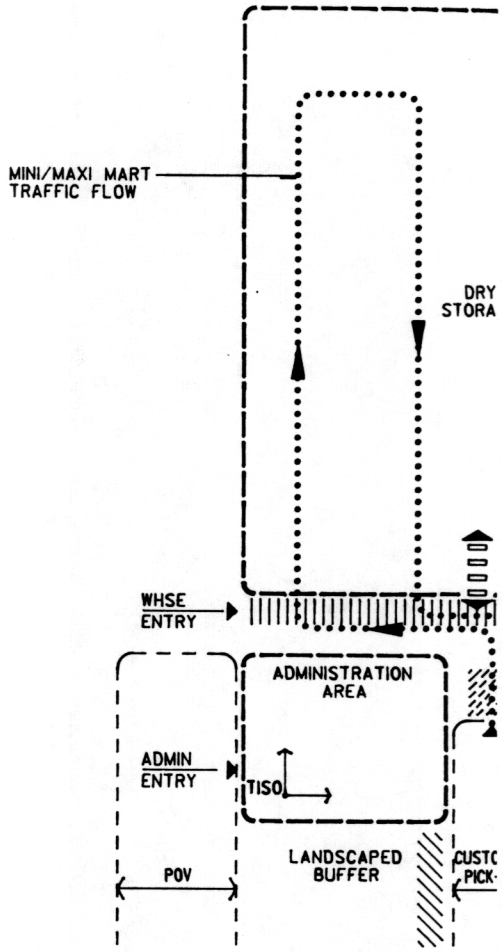
Storage Areas

Six specific areas are included in this facility to accommodate the various products stored; dry storage, sensitive and hardy vegetable & fruit coolers (two temperatures), perishable cooler, onion & potato cooler and the freezer. These areas are further organized along the spine in zones of dry, four types of cooler and the freezer. The coolers and the freezer are separated by a maxi mart aisle by which customers gain access to product stored in case flow racks. The "reach-through" ability within the aisle is an optional element of the design. A secondary service aisle is incorporated between the dry storage and coolers to allow replenishment of stock within the coolers by warehouse personnel. This service aisle may be relocated to replace the maxi mart aisle in those facilities which do not implement the maxi mart option.

Support

This zone of the facility, which is 40 feet wide in the small TISA and 50 feet wide in the medium and large TISA , runs the entire length of the storage areas. A 12 feet wide circulation zone is located directly adjacent to storage areas. This zone is dedicated to cart and material handling equipment circulation. Material handling equipment storage and battery charging is located in the dry dock area adjacent to an exterior wall in the small TISA and within an enclosed area in the chilled dock in the medium and large TISA. Four wheel cart storage is located on the dry dock and is placed immediately adjacent to customer pick-up and delivery parking.

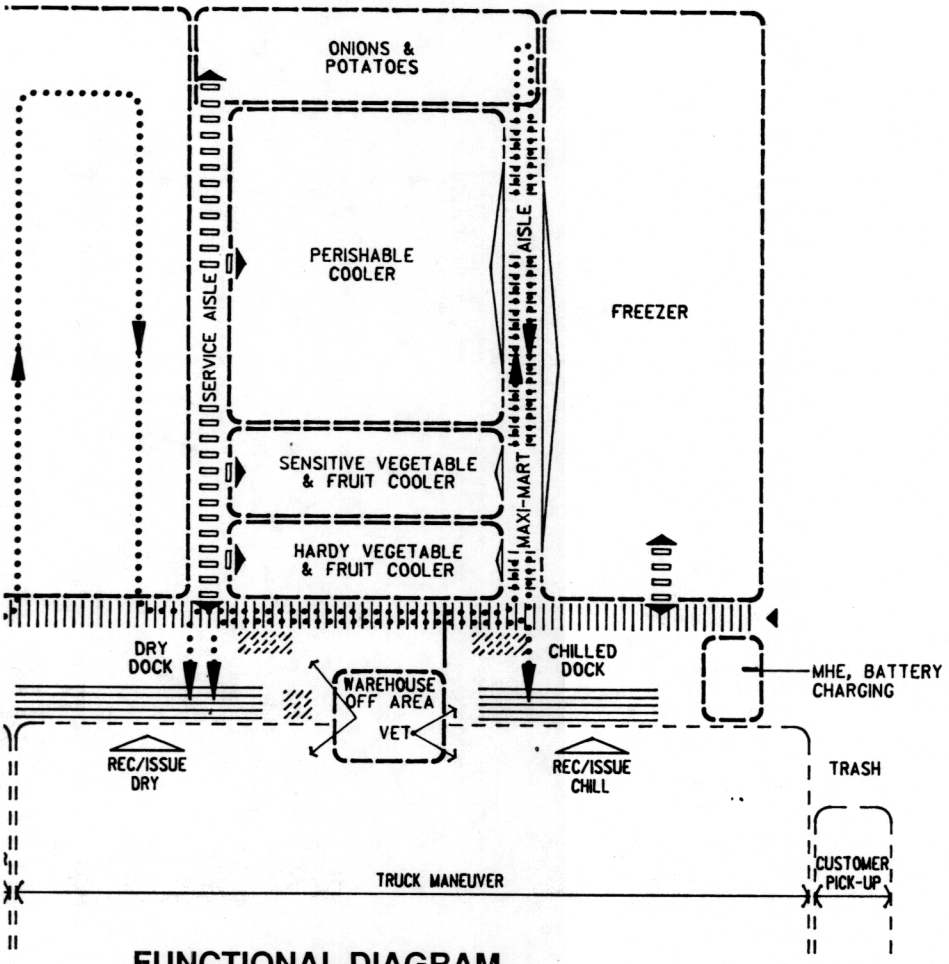
The remainder of the support area is divided between the dry and chilled docks. These docks serve as multiple function areas which include receiving/issuing, staging and holding, unit piles, veterinary inspection and a salvage area adjacent to a wall with a floor drain, small 3 compartment sink with drainboard and space for a table and stand-up storage shelf. This area shall be kept column free and open to allow the flexibility required in a multi-function space. Delineation of various functions via



painted floor treatments will aid in the organization of the space.

Warehouse Office

The length of the support space in the medium and large facilities allows for central location of the warehouse office between the dry and chilled docks. In the small facility this area has been combined with the administration due to the length of dock required. The warehouse office includes space for office personnel, driver waiting, janitor's closet and the veterinary office and inspection room. The veterinary area is located to have direct visual access to the dock area as well as incoming trucks. A secondary means of egress is also required from the veterinary office.



FUNCTIONAL DIAGRAM

MEDIUM & LARGE TISA

Existing military criteria for the veterinary office / lab with respect to size and equipment shall be followed. The warehouse office is the central control point for all warehouse and dock functions. Consideration should be given to glazing this area in order to maintain visual access. Driver waiting is located within the warehouse office in order to limit access to the facility by unauthorized personnel.

Administration

The Administrative area provides direct and indirect support to the warehouse functions. Vending, break-training and toilet areas are accessible from the support spine while the TISO, general administration and conference room are oriented to the POV parking and differentiated by appropriate materials and considerations. An enclosed office is provided for the TISO with view to general administration while the remainder of space is open office to maintain flexibility within.

Flexibility and expansion are accomplished in the organization of administrative/warehouse offices and storage areas on opposite sides of the linear support spine. A maximum total of 25% expansion to the individual storage areas is required as indicated on the site plan. Expansion may vary by ration type and storage aid required, however, it is generally limited to parallel with and opposite to the support spine. A column and beam structure eliminates the need for bearing walls in the storage areas and further enables ease of expansion. Careful consideration should be given to the roof slope in order to avoid limitation of expansion or available storage height in the designated directions.

Traffic flow

General flow through the facility is indicated on the diagram above. After parking, the customer enters adjacent to the four wheel cart storage. From that point, utilizing the circulation spine, the dry storage area is accessed. Circulation continues along the spine into the chilled dock. A secondary circulation zone, perpendicular to the chilled dock, contains the reach-through option of access to the coolers and freezer. This maxi mart aisle also contains doors for access by personnel and four wheel carts only. Material handling equipment used to replenish the coolers is confined to the secondary service aisle. Product is then brought back to the unit pile areas for inspection by warehouse personnel and eventual staging for final issue.

This design is capable of handling customer shopping which is referred to as mini, maxi or mini/maxi mart throughout this package. The following are definitions of each:

- mini mart - customer shopping in dry storage only.
- maxi mart - customer shopping in coolers and freezer only.
- mini/maxi mart - customer shopping throughout all storage areas.

SITE DEVELOPMENT REQUIREMENTS

The preferred site plans included in this package have been developed to show the typical relationships between the facility, designated expansion areas, POV parking, customer and delivery parking, maneuvering and access to and within the site for both pedestrians and vehicles. The site plan allows for 25% expansion of the key storage areas within the facility without impact to adjoining sites. In addition, a 60 foot separation of structures is assumed for purposes of site area calculations. The separation may vary depending on the site selected.

Key considerations involved in site selection include: access to the installation truck roadway network, warehouse building type relative to the industrial zone, segregation of incoming tractor trailers from the non-industrial base zones, adequate site area, available utilities, indirect access to rail as a contingency, and adjacency to motor pools.

Circulation within the site should pay particular attention to three vehicle types. These types include POV for visitors and employees, customers pick-up and delivery trucks and the primary delivery trucks (18 wheelers) including commercial vendors with their associated maneuvering area. Each vehicle area is designed to allow direct access to its facility entry. For example, all employees enter the facility from the POV parking directly to the warehouse or administrative area accordingly. The customer pick-up and delivery parking has been located adjacent to the main maneuvering area which has access to the dry and chilled dock doors. This parking has been incorporated to eliminate dock doors being utilized during the time customers park for mini/maxi mart use. Customers entering the site for pre-picked orders would go directly to the appropriate dock door.

The site has been designed to allow primary access to the facility directly from an installation industrial service road. If such access is unavailable, careful attention should be given to secondary service roads and their ability to accommodate the required vehicles. The site topography should be considered when orienting the building within the site provided that other factors such as building orientation relative to energy considerations are not compromised.

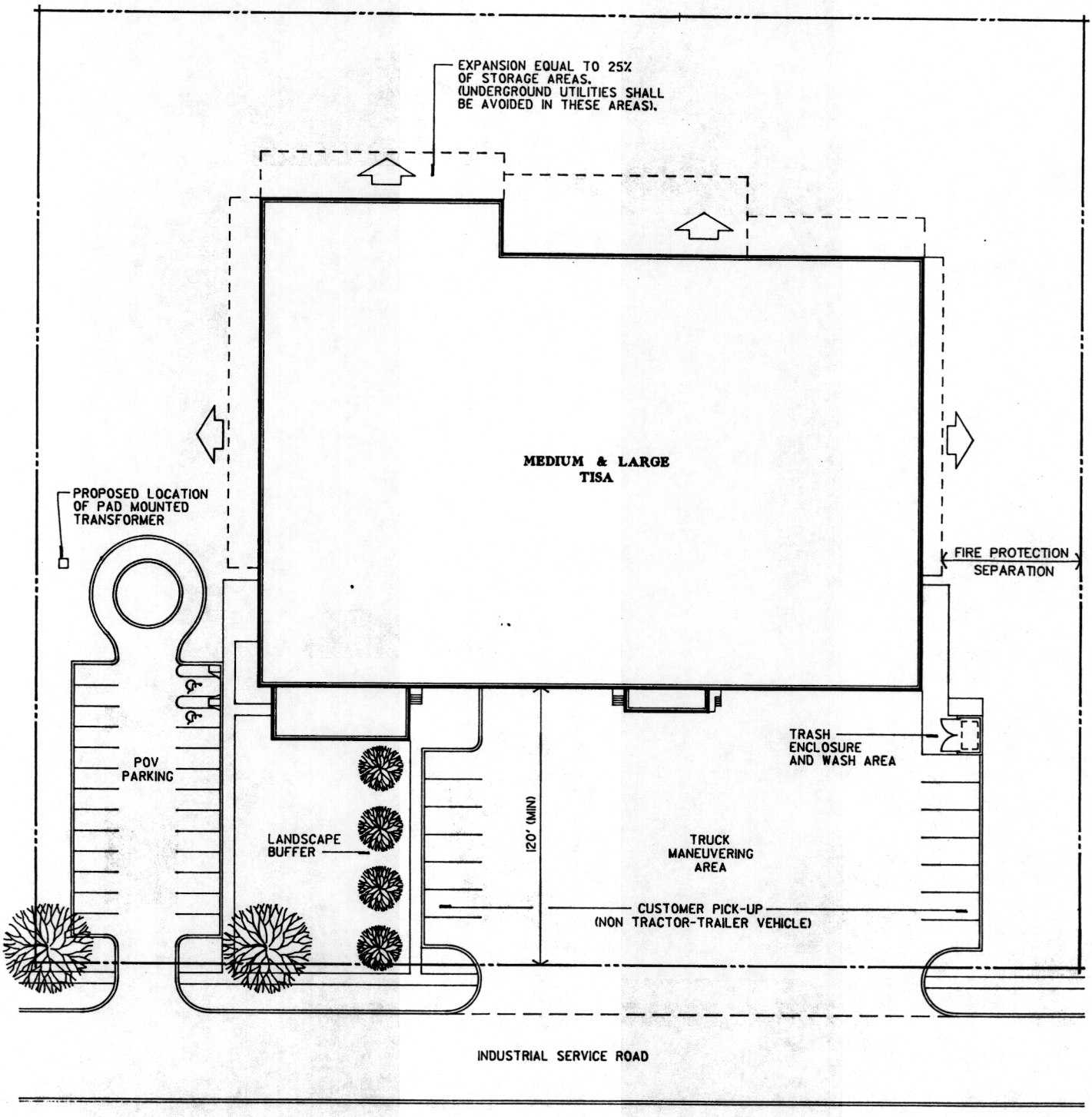
When possible the building should be oriented to take advantage of sloping terrain by utilizing natural site grades to develop the elevation differential required at the truck loading docks. Where natural site grades cannot be utilized advantageously, preference should be given to maintaining the building floor level close to the existing site grades and excavating for the loading dock area rather than raising the entire building. This situation will require that the site adapt designer analyze the drainage conditions carefully including the potential for additional runoff from the adjacent service road. Factors such as ground water elevation and flood criteria will also impact the overall solution.

Handicapped accessibility to the facility shall be provided through administration and warehouse entries from the POV parking. Handicapped parking as required should be incorporated directly adjacent to the building entry.

Landscaping is not a required element of the design nor essential to the facility type. However, consideration should be given to providing a pocket of landscaping to buffer the truck maneuvering from the administration area and at the entry to the POV parking.

Signage in keeping with TM-5-807-10, December, 1983 and the installation's standard should be incorporated to identify the facility. It is also recommended that truck dock doors be numbered to alleviate confusion for trucks entering the site. Further signage may be desired to delineate various types of parking on the site.

Provisions for physical security/anti-terrorism shall be determined and incorporated by the using agency. The Omaha District Engineer Office Protective Design Center of Expertise will provide technical guidance upon request.

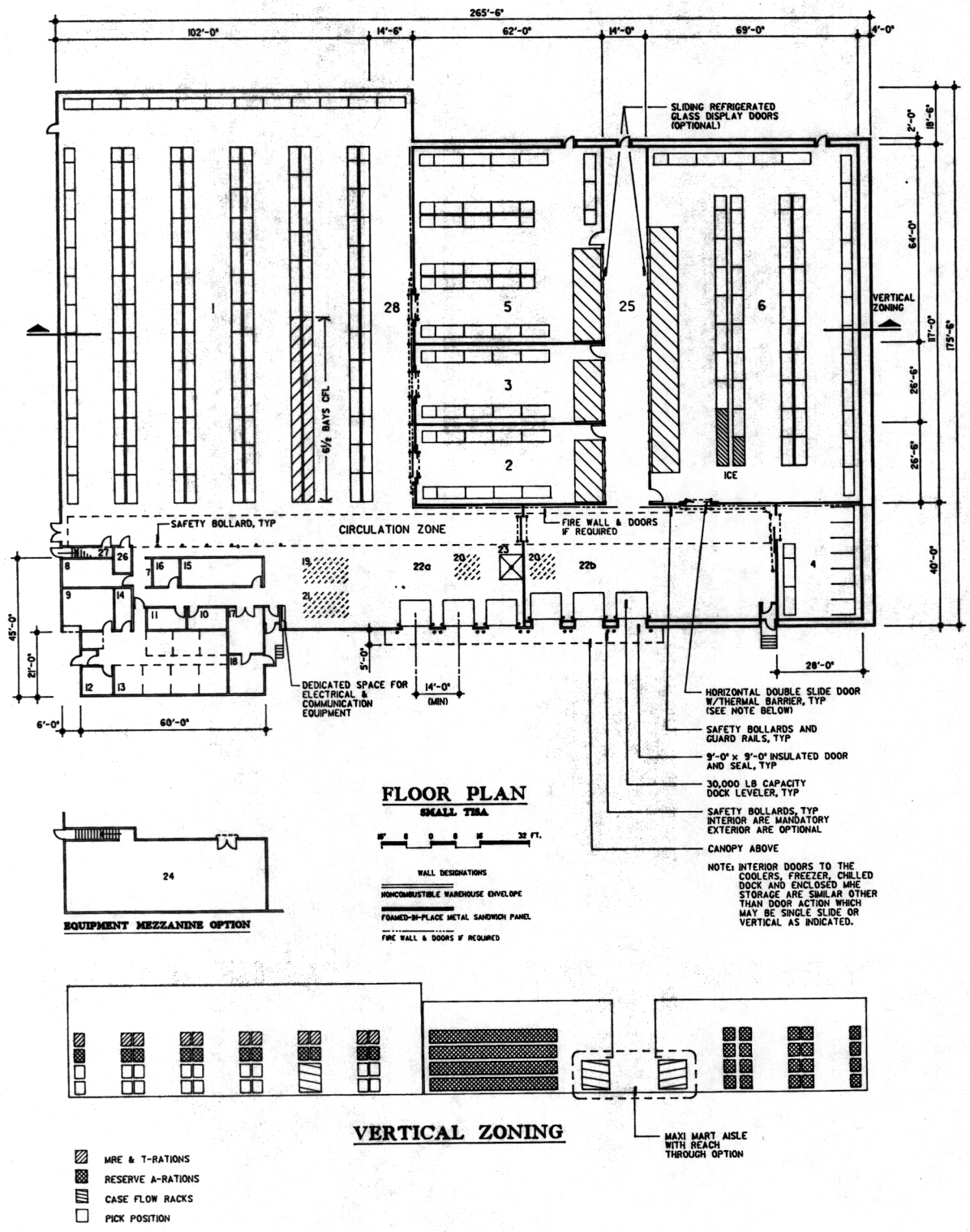


SITE PLAN

MEDIUM & LARGE TISA

30' 15 0 30 60 FT.

SMALL FACILITY



DESIGN OBJECTIVES

BUILDING DATA

AREA	No.	SPACE	STORAGE TEMPERATURES	NET S.F.
STORAGE AREAS	1	Dry storage		13,973
	2	Hardy vegetable & fruit cooler	40-45° F	1,599
	3	Sensitive vegetable & fruit cooler	32-34° F	1,599
	4	Onions & potatoes	55-60° F	1,066
	5	Perishable cooler	32-35° F	3,875
	6	Freezer	-10° F	7,888
ADMINISTRATIVE AREA	7	Vending		18
	8	Break/training		160
	9	Conference room		216
	10	Men - toilets & lockers		84
	11	Women - toilets & lockers		84
	12	TISO		90
	13	General administration (12-18)		837
	14	Storage		74
WAREHOUSE OFFICE AREA	15	Warehouse office (4)		221
	16	Driver waiting		73
	17	Inspection room		172
	18	Veterinary office		138
SUPPORT	19	Cart storage		
	20	Unit pile		
	21	Mhe storage, battery charging		
	22	Staging, holding, vet inspection		
		a. dry dock		
		b. chilled dock	45° F	
	23	Salvage area (see sheet 2 narrative)		
		Total for dock circulation and activities		7,527
	24	Equipment mezzanine		1,495
	25	Maxi-mart aisle	45° F	1,631
	26	Janitor closet (1)		20
	27	Sprinkler valve room		16
	28	Service aisle (coolers)		1,620
		Wall thickness, etc.		2,438 *
		Gross square feet (total)		46,914

TROOP CAPACITY

Barrack capacity	5,000
Cash sales (15%)	*713
Hospitals	100
Reserves (weekend)	1,000
Reserves (14 days)	750
T-rations	2,500
MRE's	2,500
B-rations	0

*.15 of 70% or 95% barrack capacity

PERSONNEL

Administration	
TISO	1
Admin. staff (5-7)	7
Warehouse	
Office	2
Warehousemen w/ mini/maxi	5
Veterinary staff	2

STORAGE CAPACITIES

STORAGE AREAS	PALLETS	FLOW LANES
Dry - A-rations	550	157
Dry - MRE & T-rations	535	N/A
Freezer	420	320
Cooler - perishable	216	120
Cooler - sensitive V & F	72	60
Cooler - hardy V & F	72	60
Onions & potatoes	72	0

MATERIAL HANDLING EQUIPMENT

Four wheel carts	**
Pallet transporters 3000 lb capacity	1
Counterbalanced forklift 3000 lb capacity/15'-6"hgt	3
Double deep forklift 3000 lb capacity/20'-6"hgt	N/A
Stock selector 3000 lb capacity/20'-0"	N/A

**To be determined by the TISA personnel based on the issue schedule and extent of mini and/or maxi mart use.

All material handling equipment shall be provided with a cold package.

STORAGE AIDS

Pallet rack	
Single deep	1,960
Double deep	0
Drive-in	
2 deep	0
3 deep	0
4 deep	0
Case flow rack	
20 faces	660
15 faces	160

The overall design objective of this Definitive Package is to establish the specific plan relationships and building configuration while allowing expansion capability and interior flexibility in site adaptation. In addition, the facility layout is designed based on the storage aid system and equipment which are included and essential in order to meet the overall objective.

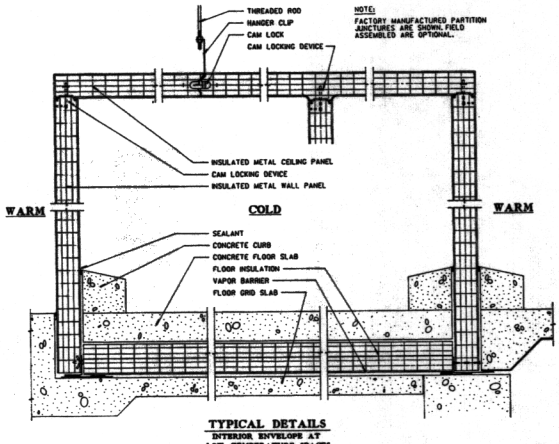
The plan shape is derived from the storage aid system, aisle width and cube required for the individual storage areas. These areas, tied to the linear support/circulation spine with the intersecting administration and warehouse office areas, form the overall plan concept.

The interior planning module for the administration and warehouse office areas may vary slightly, however an approximate module of 10 feet will allow for the flexibility in accommodating multiple work stations. These areas require acoustical separation from the warehouse. A minimum STC of 40 to 45 shall be provided. These areas shall have typical office finishes including acoustical tile ceilings, painted gypsum wallboard and carpeting. The administrative and warehouse office areas and their support spaces should be handicapped accessible.

A U.S.D.A. approved finish shall be provided on all interior surfaces in the storage and support spaces. All other finishes for these spaces shall be U.S.D.A approved including the storage aid system, concrete masonry units, etc.

Interior signage for the facility is optional. However, consideration should be given to providing general product location signage which is flexible at both the dry storage row ends and in the secondary circulation accessing the coolers and freezer. Floor demarcation of defined areas within the support space such as the unit pile, circulation zones and customer flow is recommended. All signage shall be in accordance with TM 5-807-10 December 1983.

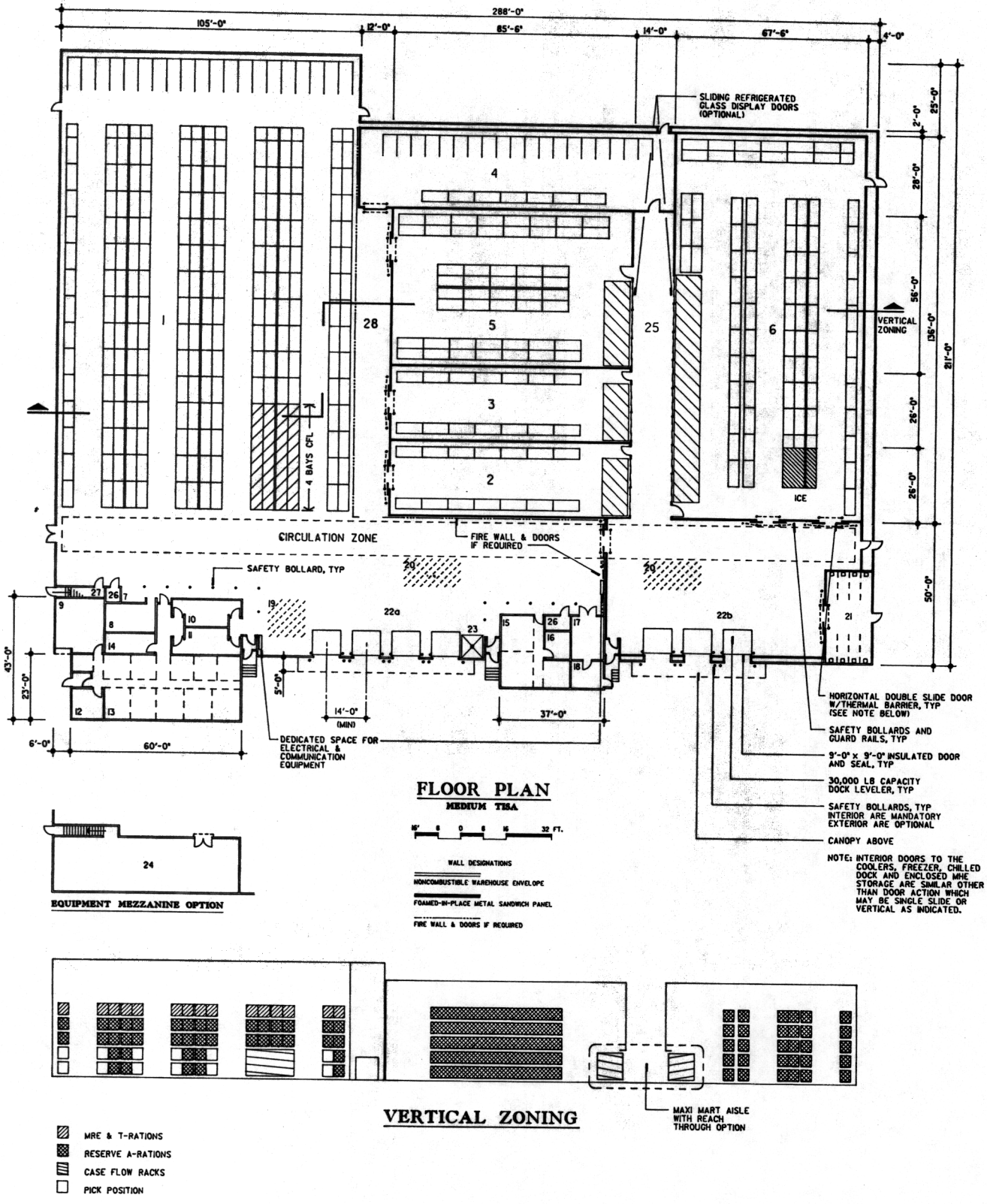
The basic occupancy classification of this building is Uniform Building Code Group-B, Division-4 for storage areas and Group-B, Division -2 Office Building Classification for the Administrative and Warehouse Office areas. Anticipated occupant loads are defined on the floor plan sheets. Special consideration should be given to the material handling equipment storage/battery charging area.



TYPICAL DETAILS
INTERIOR ENVELOPE AT LOW TEMPERATURE SPACES

PLAN DESIGNATION

MEDIUM FACILITY



STORAGE AID SYSTEMS

BUILDING DATA

AREA	NO.	SPACE	STORAGE TEMPERATURES	NET S.F.
STORAGE AREAS	1	Dry storage		16,692
	2	Hardy vegetable & fruit cooler	40-45° F	2,155
	3	Sensitive vegetable & fruit cooler	32-34° F	2,155
	4	Onions & potatoes	55-60° F	3,066
	5	Perishable cooler	32-35° F	4,647
	6	Freezer	-10° F	8,978
ADMINISTRATIVE AREA	7	Vending		18
	8	Break/training		172
	9	Conference room		316
	10	Men - toilets & lockers		177
	11	Women - toilets & lockers		177
	12	TISO		115
	13	General administration (12-18)		1,157
	14	Storage		122
WAREHOUSE OFFICE AREA	15	Warehouse office (4)		444
	16	Driver waiting		81
	17	Inspection room		160
	18	Veterinary office		99
SUPPORT	19	Cart storage		
	20	Unit pile		
	21	Mhe storage, battery charging		
	22	Staging, holding, vet inspection		
		a. dry dock		
		b. chilled dock	45° F	
	23	Salvage area (see sheet 2 narrative)		
		Total for dock circulation and activities		12,014
	24	Equipment mezzanine		1,235
	25	Maxi-mart aisle	45° F	1,505
	26	Janitor closet (2)		68
	27	Sprinkler valve room		16
	28	Service aisle (coolers)		1,290
		Wall thickness, etc.		2,768
		Gross square feet (total)		59,627

TROOP CAPACITY

Barrack capacity	15,000
Cash sales (15%)	2,138*
Hospitals	400
Reserves (weekend)	2,500
Reserves (14 days)	2,500
T-rations	5,000
MRE's	5,000
B-rations	0

* .15 of 70% or 95% barrack capacity

PERSONNEL

Administration	
TISO	1
Admin. staff (8-11)	11
Warehouse	
Office	3
Warehousemen w/ mini/maxi	8
Veterinary staff	2

STORAGE CAPACITIES

STORAGE AREAS	PALLETS	FLOW LANES
Dry - A-rations	1,327	140
Dry - MRE & T-rations	1,069	N/A
Freezer	860	320
Cooler - perishable	500	100
Cooler - sensitive V & F	140	60
Cooler - hardy V & F	140	60
Onions & potatoes	260	0

MATERIAL HANDLING EQUIPMENT

Four wheel carts	**
Pallet transporters 3000 lb capacity	1
Counterbalanced forklift 3000 lb capacity/15'-6"hgt	2
Double deep forklift 3000 lb capacity/20'-6"hgt	4
Stock selector 3000 lb capacity/20'-0"	OPTIONAL

**To be determined by the TISA personnel based on the issue schedule and extent of mini and/or maxi mart use.

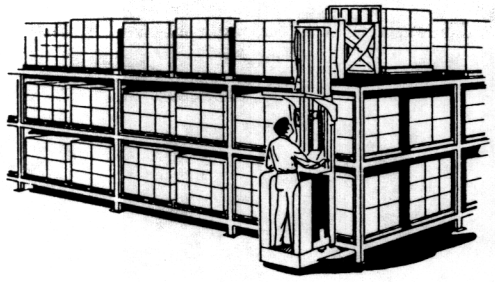
All material handling equipment shall be provided with a cold package.

STORAGE AIDS

Pallet rack	
Single deep	945
Double deep	2,876
Drive-in	
2 deep	260
3 deep	300
4 deep	0
Case flow rack	
20 faces	560
15 faces	120

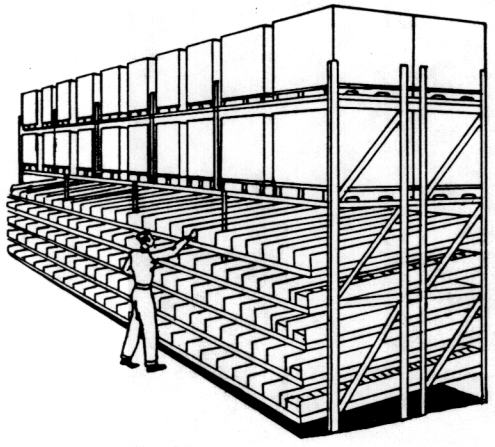
Single & Double Deep Rack

The primary storage module for A-Rations in the small facility is the single deep rack in four high modules. Double deep racks, five modules high, are used in the medium and large facilities. The first and second tier of the rack system are used for pick issue operation. The remaining storage locations above the pick locations are used for reserve storage pallets of A-Rations, MRE and T-Rations.



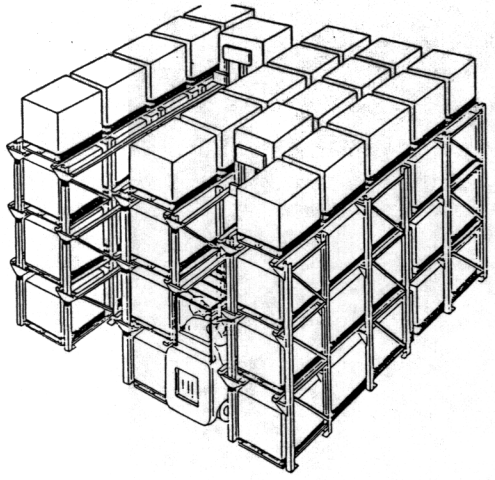
Case Flow Rack

The case flow racks are utilized for the storage of small lot items. They are installed at floor level within a single deep pallet rack bay two pallets wide. The flow lanes extend through two rack bays and are replenished from one aisle and picked from the other. The case flow rack module provides 24 case flow lanes on the average and provides for reserve pallet locations for four pallets on each aisle side of the module.

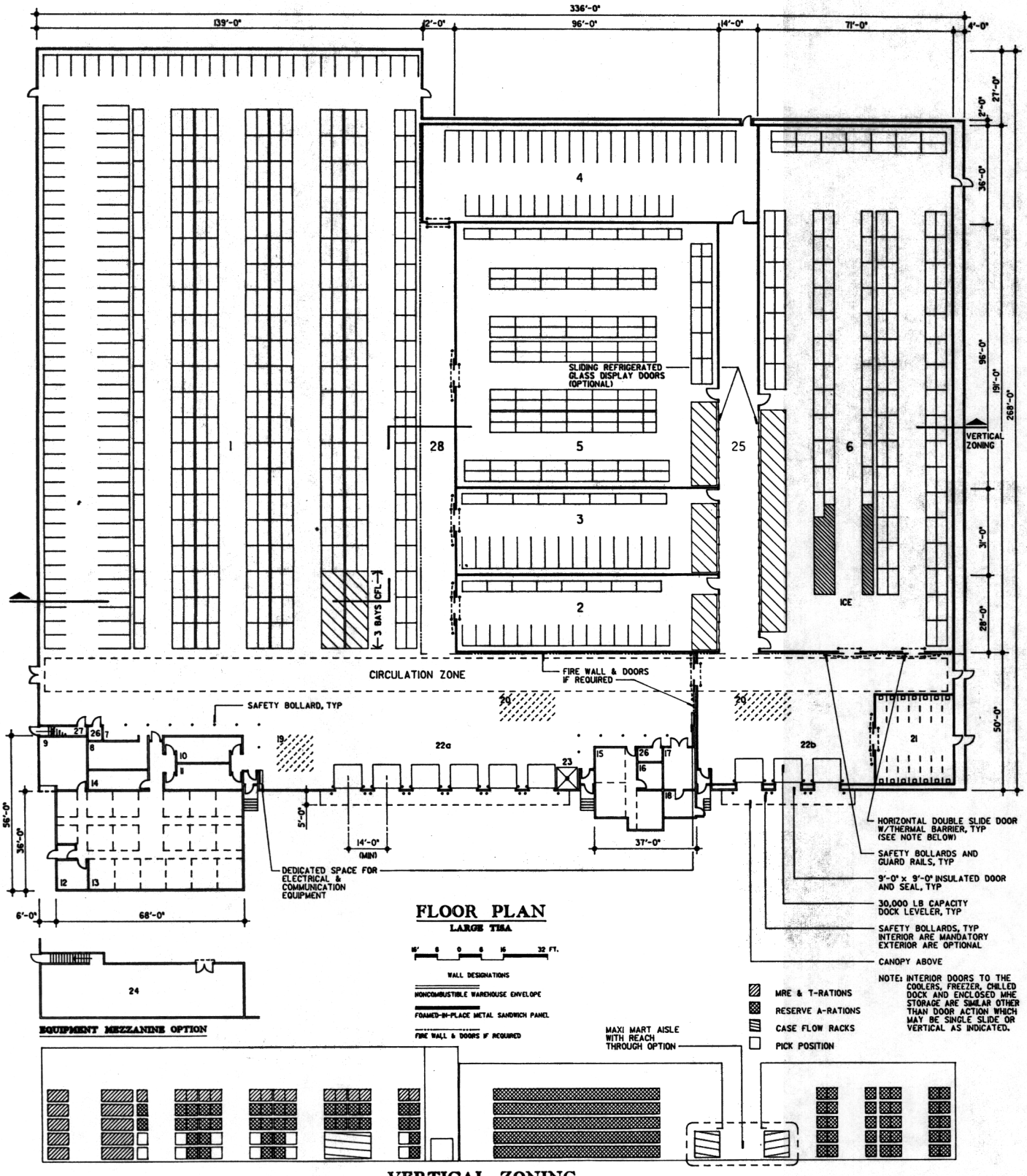


Drive-in Rack

Two and three deep drive-in racks are used to store MRE's, T-Rations and UHT milk inventories which cannot be satisfied by the excess capacity in the single-deep rack after the storage of all A-Rations.



LARGE FACILITY



MATERIAL HANDLING EQUIPMENT

BUILDING DATA

AREA	No.	SPACE	STORAGE TEMPERATURES	NET S.F.
STORAGE AREAS	1	Dry storage		30,015
	2	Hardy vegetable & fruit cooler	40-45° F	2,613
	3	Sensitive vegetable & fruit cooler	32-34° F	2,945
	4	Onions & potatoes	55-60° F	4,270
	5	Perishable cooler	32-35° F	9,073
	6	Freezer	-10° F	13,300
ADMINISTRATIVE AREA	7	Vending		27
	8	Break/training		202
	9	Conference room		238
	10	Men - toilets & lockers		236
	11	Women - toilets & lockers		236
	12	TISO		110
	13	General administration (12-18)		2,114
	14	Storage		147
WAREHOUSE OFFICE AREA	15	Warehouse office (4)		507
	16	Driver waiting		81
	17	Inspection room		160
	18	Veterinary office		99
SUPPORT	19	Cart storage		
	20	Unit pile		
	21	Mhe storage, battery charging		
	22	Staging, holding, vet inspection		
		a. dry dock		
		b. chilled dock	45° F	
	23	Salvage area (see sheet 2 narrative)		
		Total for dock circulation and activities		14,220
	24	Equipment mezzanine		1,387
	25	Maxi-mart aisle	45° F	2,170
	26	Janitor closet (2)		68
	27	Sprinkler valve room		16
	28	Service aisle (coolers)		1,860
		Wall thickness, etc.		3,365
		Gross square feet (total)		89,519

TROOP CAPACITY

Barrack capacity	25,000
Cash sales (15%)	3,563*
Hospitals	800
Reserves (weekend)	5,000
Reserves (14 days)	5,000
T-rations	10,000
MRE's	10,000
B-rations	0

*.15 of 70% or 95% barrack capacity

PERSONNEL

Administration	
TISO	1
Admin. staff (12-18)	18
Warehouse	
Office	3
Warehousemen w/ mini/maxi	16
Veterinary staff	3

STORAGE CAPACITIES

STORAGE AREAS	PALLETS	FLOW LANES
Dry - A-rations	2,163	68
Dry - MRE & T-rations	2,138	N/A
Freezer	1,370	320
Cooler - perishable	940	120
Cooler - sensitive V & F	184	60
Cooler - hardy V & F	244	75
Onions & potatoes	288	0

MATERIAL HANDLING EQUIPMENT

Four wheel carts	**
Pallet transporters 3000 lb capacity	2
Counterbalanced forklift 3000 lb capacity/15'-6"hgt	4
Double deep forklift 3000 lb capacity/20'-6"hgt	7
Stock selector 3000 lb capacity/20'-0"	OPTIONAL

**To be determined by the TISA personnel based on the issue schedule and extent of mini and/or maxi mart use.

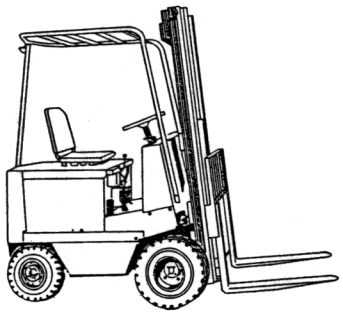
All material handling equipment shall be provided with a cold package.

STORAGE AIDS

Pallet rack	
Single deep	718
Double deep	4,960
Drive-in	
2 deep	1,068
3 deep	765
4 deep	0
Case flow rack	
20 faces	540
15 faces	180

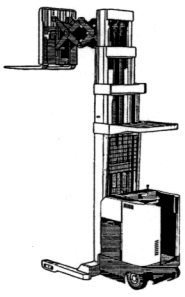
Counterbalanced Forklift

The electrically powered four wheel counterbalanced forklift is a vehicle with fixed forks mounted on its front. All man-ride four wheel counterbalanced forklifts are of the sit-down type. Counterbalanced forklifts normally used in the handling of palletized subsistence items have maximum weight handling capacities of 3,000 to 4,000 pounds depending on the lift height requirements. Maximum lifting heights range from 12 to 18 feet.



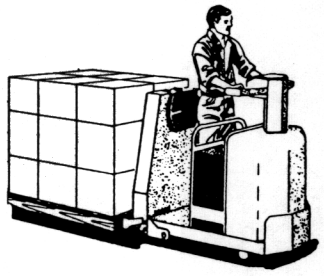
Double Deep Forklift

The double deep forklift provides storage lift capability well above those of a counterbalanced forklift. The double deep forklift attains its stability from outriggers on the front of the vehicle. The length of the outriggers require that the first level of storage be elevated above the floor on a rack beam to allow the outrigger to extend under the first level of pallets. Lifting heights range from 20 to 33 feet.



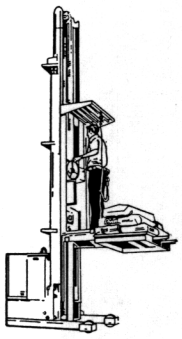
Pallet Transporter

The pallet transporter is a battery powered vehicle available in man-ride and non-riding configurations. It has the capability to lift a pallet approximately 4 inches above the floor to transport the pallet. Man-ride pallet transporters should be used for travel distances greater than 100 feet. The vehicle is very productive in transporting pallet loads of material where storage and retrieval from elevated storage locations is not required and for loading or unloading over-the-road trailers.



Stock Selector (Optional)

The stock selector is an electrically powered vehicle with pallet forks and a cab which can elevate to a maximum height of 33 feet. The vehicle can be used to pick issues, inspect stock, replenish case flow lanes with less than full pallet quantities of inventory, or provide direct put-away (hand stacking) of pallets with multiple items.



WAREHOUSE CONSIDERATIONS / SYSTEMS

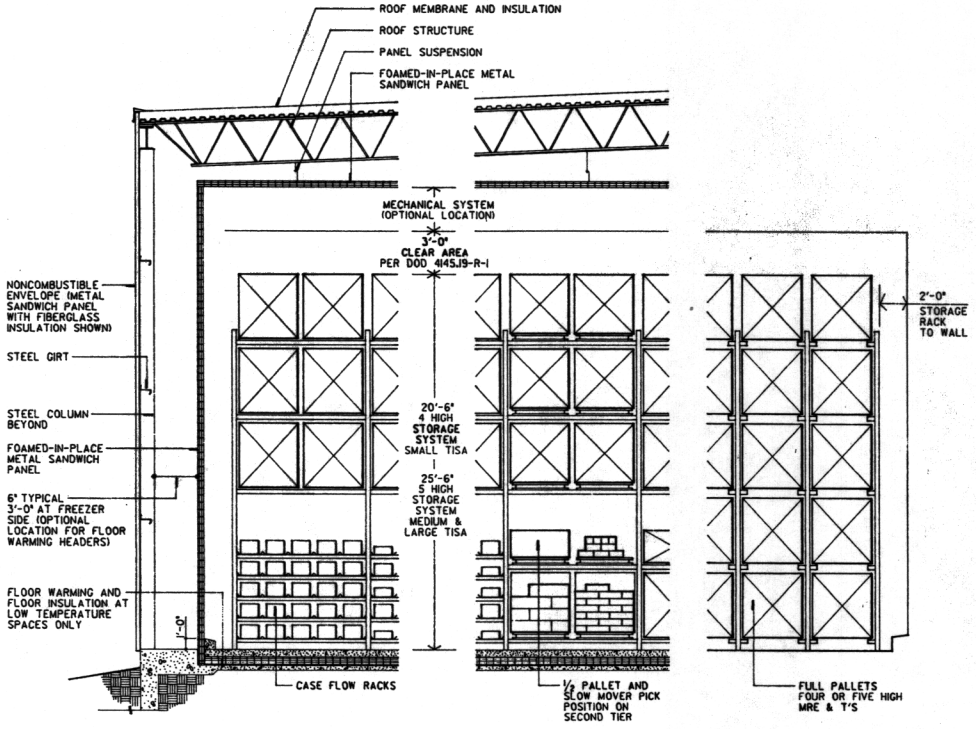
The warehouse designs have been developed using state-of-the-art storage aids and material handling equipment based on the range of storage inventories and throughput requirements for a small, medium and large TISA. The storage layout optimizes the mini/maxi mart concept of customer self service issue within an efficient palletized unit load storage warehouse with maximum expandibility.

The small TISA warehouse throughput rate is such that the use of multiple types of material handling vehicles, one type for dock operations and an alternate type for storage support operations, would produce low utilization of each type of vehicle and a loss in productivity when an operator changes vehicles. The counterbalanced forklift accommodates vehicle loading /unloading as well as storage related functions of the single deep pallet rack in a 12 foot storage aisle and end aisle. Electric pallet transporters (pallet jacks) are utilized to support issue functions in the storage areas not included in the mini/maxi mart concept. Four wheel carts are utilized by the mini/maxi mart customers.

The medium and large TISA's utilize a combination of single and double deep pallet racks to efficiently store larger inventory lots at a higher turnover rate using a deep reach forklift operating in a 10 feet wide aisle. The aisle supporting the drive-in rack for MRE, T-Ration and vegetable and fruit coolers are 12 feet wide. This permits optional direct storage to vehicle loading for contingency situations. End aisles are 12 feet wide to allow easy vehicle turns.

Inventory is stored in racks within a vertical zone concept. The first and second levels of the single and double deep racks are used as issue pick locations. The third level and above are used for reserve stock storage and any remaining capacity above the stock reserve for storage of MRE, T-ration and T-ration supplement items. Additional storage capacity for MRE, T-ration and T-ration supplement items is provided in drive-in racks. Case flow racks provide one lane for full cases and another for open cases for those items with small inventories. As an option, the case flow rack can be increased to provide issue locations for all stock items stored in the second level pallet locations.

A computerized interactive stock locator system in combination with single deep pallet racks and multiple deep drive-in pallet racks, when required for large quantities of MRE and T-rations, provides for efficient utilization of storage space and improved management control. Portable hand held computer



TYPICAL SECTION
WAREHOUSE

TYPICAL ELEVATIONS
STORAGE AIDS

terminals with bar code readers are utilized for physical inventory validation, receipt take-up, mini/maxi mart check-out and veterinary inspection of stock.

Receipts are unloaded and staged on the dock for veterinary inspection. After inspection, material is stored in locations determined by computer with designated zones based on commodity and issue frequency considerations. Order selection is from pallets and flow racks at floor level with some slow moving items of half pallet or less quantity on the second level. Unit piles, if used, are stored in the dock area along the circulation zone aisle.

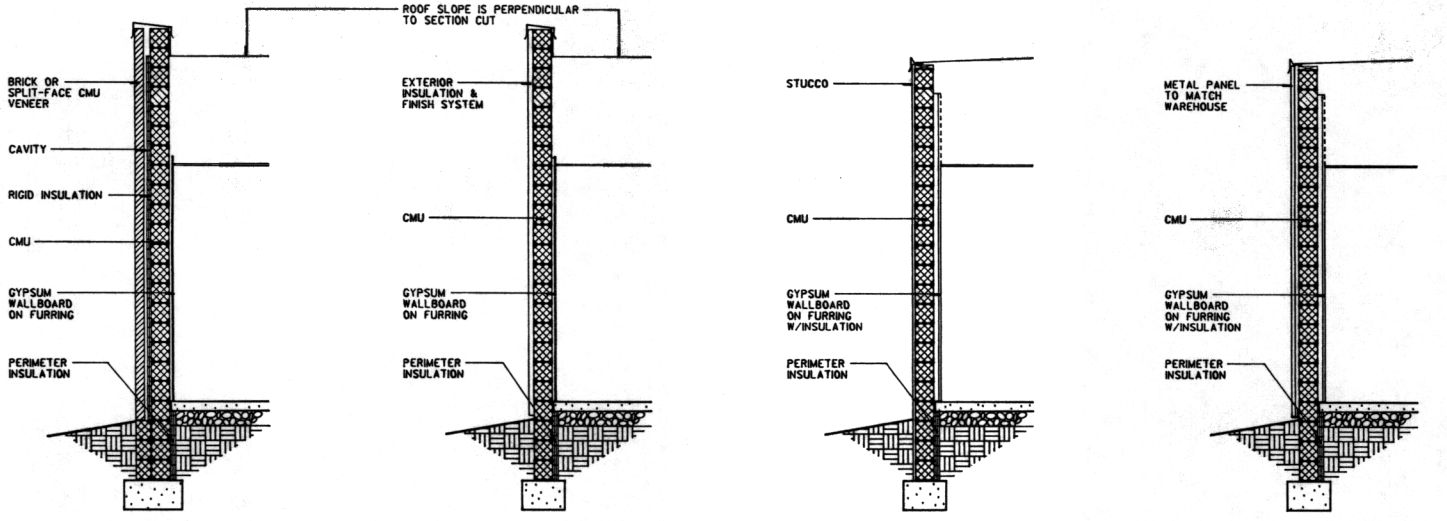
Pallet racks may be utilized above the dock doors for storage of empty pallets. Storage aid system design within various seismic zones shall be in accordance with UBC and the Rack Manufacturers Institute (RMI).

The recommended structural system consists of galvanized metal roof deck supported on joists, spanning between frames of wide flange beams supported on columns. The steel structure will provide for ease of erection along with the flexibility required to integrate a column grid into the storage aid system and aisle configuration. The roof structure shall be designed to support the loads imposed by any suspended ceilings including the ceilings in the low temperature spaces. The recommended warehouse exterior envelope will consist of metal panels spanning between steel girts supported by exterior columns. The administrative and warehouse office area walls shall consist of load bearing masonry with an option of four different exterior finishes.

Spread footings and concrete slab on grade are indicated as the basic foundation and floor slab systems.

Foundations and floor slab designs should address the site specific building based on the local site conditions, soils reports and recommendations. The slab on grade shall be designed to adequately support loading from the storage aid system and traffic from the material handling equipment. An independent column, beam and joist structure shall be provided in dry storage, dry dock coolers, maxi mart aisle, chilled dock and freezer. It is essential that the structure not penetrate the thermal barrier.

Complete structural designs must follow the recommendations and requirements as set forth in Technical Manuals TM5-809-1/AFM 88-3, Chapter 1, for load assumptions for buildings and TM5-809-10/AFM 88-3, Chapter 13 for seismic design and TM5-809-3/AFM 88-3, Chapter 3 for masonry structural design for buildings.



WALL TYPE "A"
LOAD BEARING
W/BRICK OR SPLIT-FACE CMU VENEER

WALL TYPE "B"
LOAD BEARING
W/EXTERIOR INSULATION & FINISH SYSTEM

WALL TYPE "C"
LOAD BEARING
W/STUCCO

WALL TYPE "D"
LOAD BEARING
W/METAL PANELS

OPTIONAL WALL TYPES
ADMINISTRATION AND WAREHOUSE OFFICE AREAS

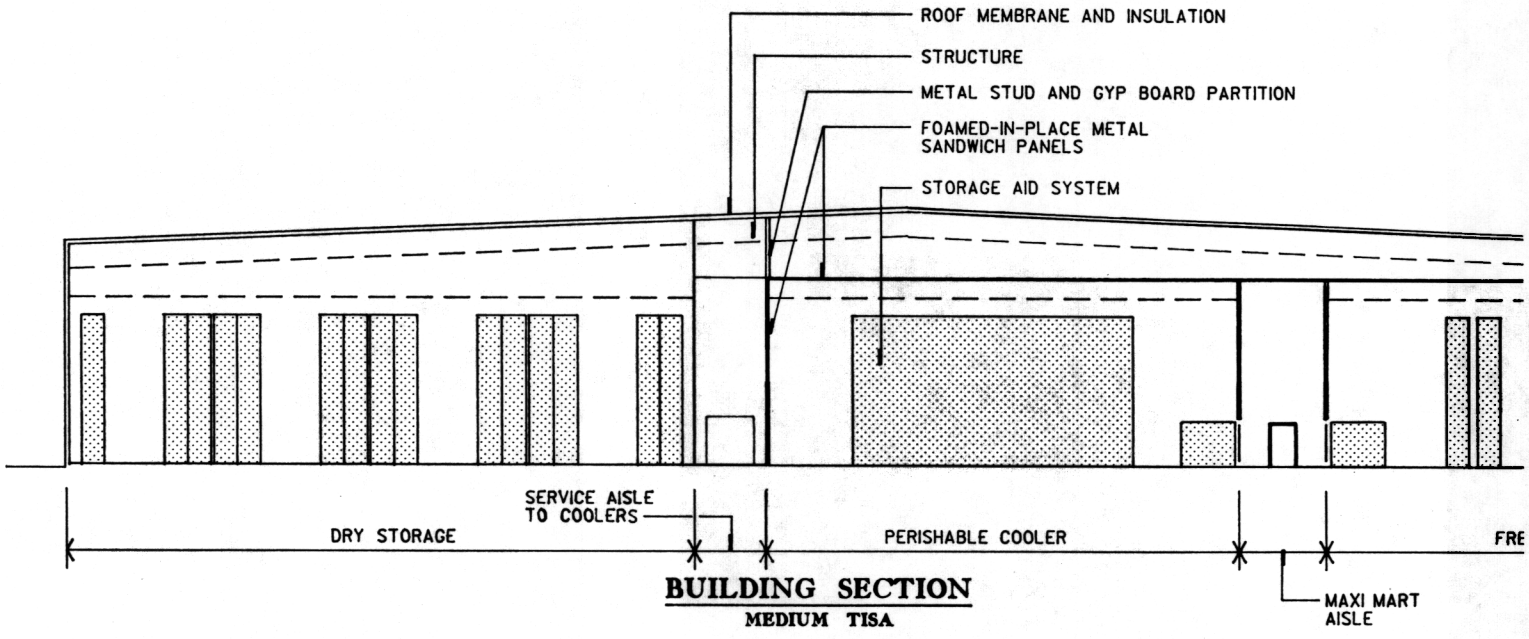
0 1 2 3 4 5 FT.

NOTES:
1. PARAPETS ARE OPTIONAL
2. MINIMUM ROOF SLOPE SHALL BE IN ACCORDANCE WITH THE ARCHITECTURAL AND ENGINEERING INSTRUCTIONS-DESIGN CRITERIA.
3. WALL TYPES "C" AND "D" INDICATE SECTION CUT IN DIRECTION OF ROOF SLOPE AND WITHOUT PARAPET.

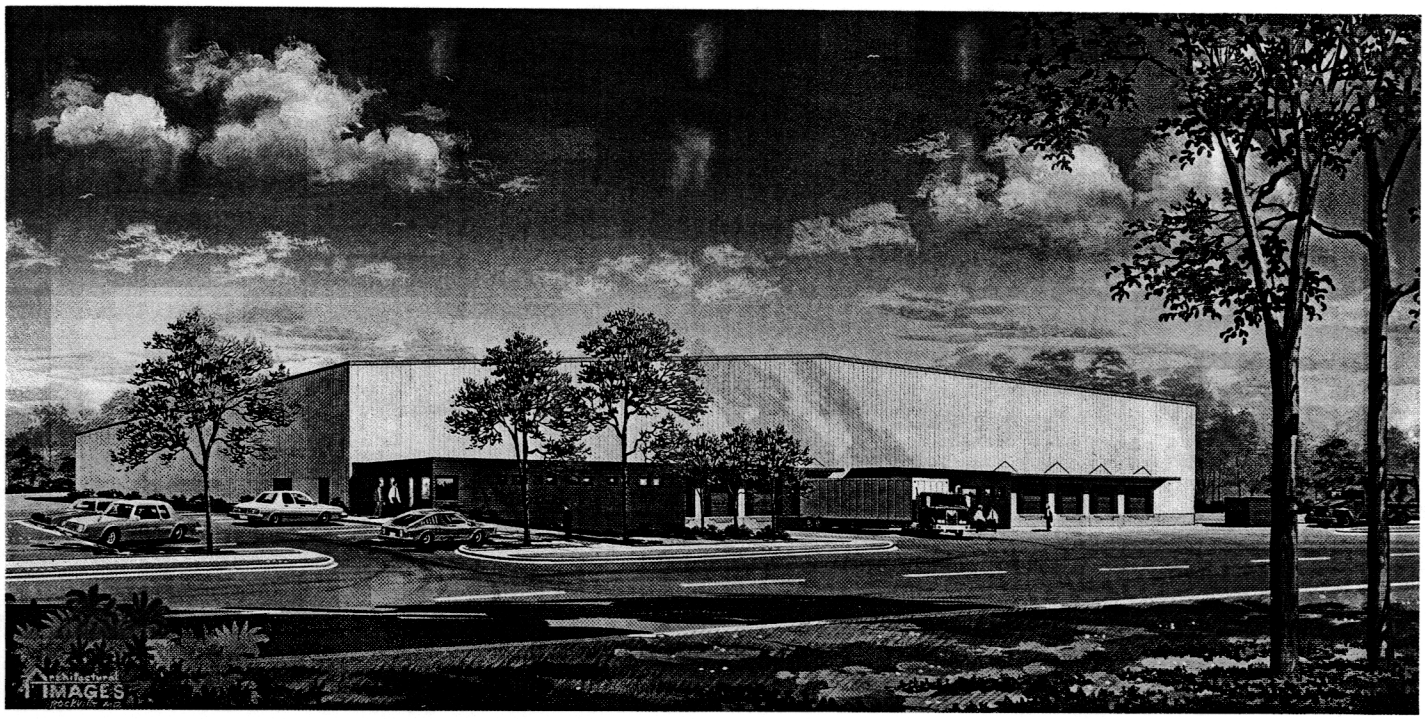
ARCHITECTURAL SYSTEMS

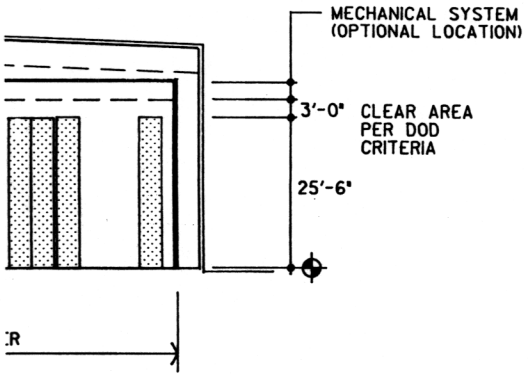
The interior and exterior image of this facility have been developed as a simple functional statement of the building type. Technical considerations, ease of expansion and the probable location of the facility within the industrial zone form the basis for recommending a metal panel exterior. Careful considerations should be given to the color of the warehouse mass and the wall type selection for the administrative and warehouse areas. Wall types ranging from brick to stucco and matching metal panels are included in order to relate to the installation's architectural theme.

The warehouse facilities are designed around the "Interior Vapor Barrier System" concept. The concept involves the utilization of a conventional noncombustible exterior envelope with an interior insulation and vapor barrier envelope within the overall building for all low temperature spaces. The interior envelope utilizes foamed-in-place metal sandwich panels for walls and ceilings with floor insulation and a floor warming system below the concrete floor slab. Quality of factory assembly of the metal panels along with proper detailing of penetrations are critical elements in maintaining continuity in the vapor barrier for the low temperature spaces. The roof of the exterior envelope shall be designed in accordance with the Architectural and Enginneering Instructions Design Criteria with respect to roof slope and material selection.



BUILDING SECTION
MEDIUM TISA





The interior cross section of the facility houses the storage aid system, clear space above per DOD criteria, utilities zone and the depth of structure. Low temperature spaces require additional height in the overall cross section due to the interior envelope within the building. Overall height is primarily dictated by the storage configuration which is a 4 high rack system in the small and 5 high in the medium and large facilities. Interior space above the administrative core is dedicated to mechanical and electrical equipment accessed by stairs directly from the exterior. Although the final location of the mechanical and electrical room is optional (site specific); direct access from the exterior is mandatory. Additional design considerations for the equipment mezzanine option include adequate ceiling structure, vibration isolation, acoustics and double doors from the mezzanine level to the interior warehouse to allow the placement and removal of equipment by the facility's material handling equipment.

Operable windows shall be provided in all occupied spaces of the administrative and warehouse office areas. Provisions for clerestories are included to obtain natural light in the dry dock area.

The Department of the Army Facilities Standardization Program was implemented to pursue the expanded use of standard facility designs for the Army's military construction programs. The thrust of this program is to develop standards in the form of definitive designs.

The purpose of a Definitive is to delineate space allocations, functional layouts and overall configurations and at the same time serve as a guide in the development of construction documents.

The application of this program to TISA Cold/Dry Storage Facilities accomplishes these goals and further provides a process by which military programmers can relate categories of troop strengths directly to subsistence inventory and storage requirements.

Unique installation requirements can be specifically defined through this planning process. The package further outlines the necessary storage aids, material handling equipment and building envelope which are required to accommodate subsistence based on the current state-of-the-art in the warehousing industry.

WOLFBERG ALVAREZ AND ASSOCIATES
ARCHITECTURE · ENGINEERING
PLANNING · INTERIOR DESIGN

Architecture . Engineering . Planning
2000 North 14th Street . Suite 230 . Arlington . Virginia

SOR/A

St. Onge, Ruff and Associates, Inc.
Material Handling Designers